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Spin dynamics of itinerant holes in HTSC cuprates: The singlet-correlated band model and its applications

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Abstract

So far calculations of the spin susceptibility in the superconducting state of cuprates have been performed in the framework of weak-coupling approximations. However, it is known that cuprates belong to Mott-Hubbard doped materials where electron correlations are important. In this paper an analytical expression for the spin susceptibility in the superconducting state of cuprates is derived within the singlet-correlated band model, which takes into account strong correlations. The expression of the spin susceptibility is evaluated using values for the hopping parameters adapted to measurements of the Fermi surface of the materials YBa2Cu3O7 and Bi 2Sr2CaCu2O8. We show that the available experimental data which are directly related to the spin susceptibility can be explained consistently within one set of model parameters for each material. These experiments include the magnetic resonance peak observed by inelastic neutron scattering and the temperature dependence of nuclear magnetic resonance properties like the spin shift and the spin-spin and spin-lattice relaxation rates in the superconducting state. © 2007 IOP Publishing Ltd.

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